

Vision of Future Air Transportation

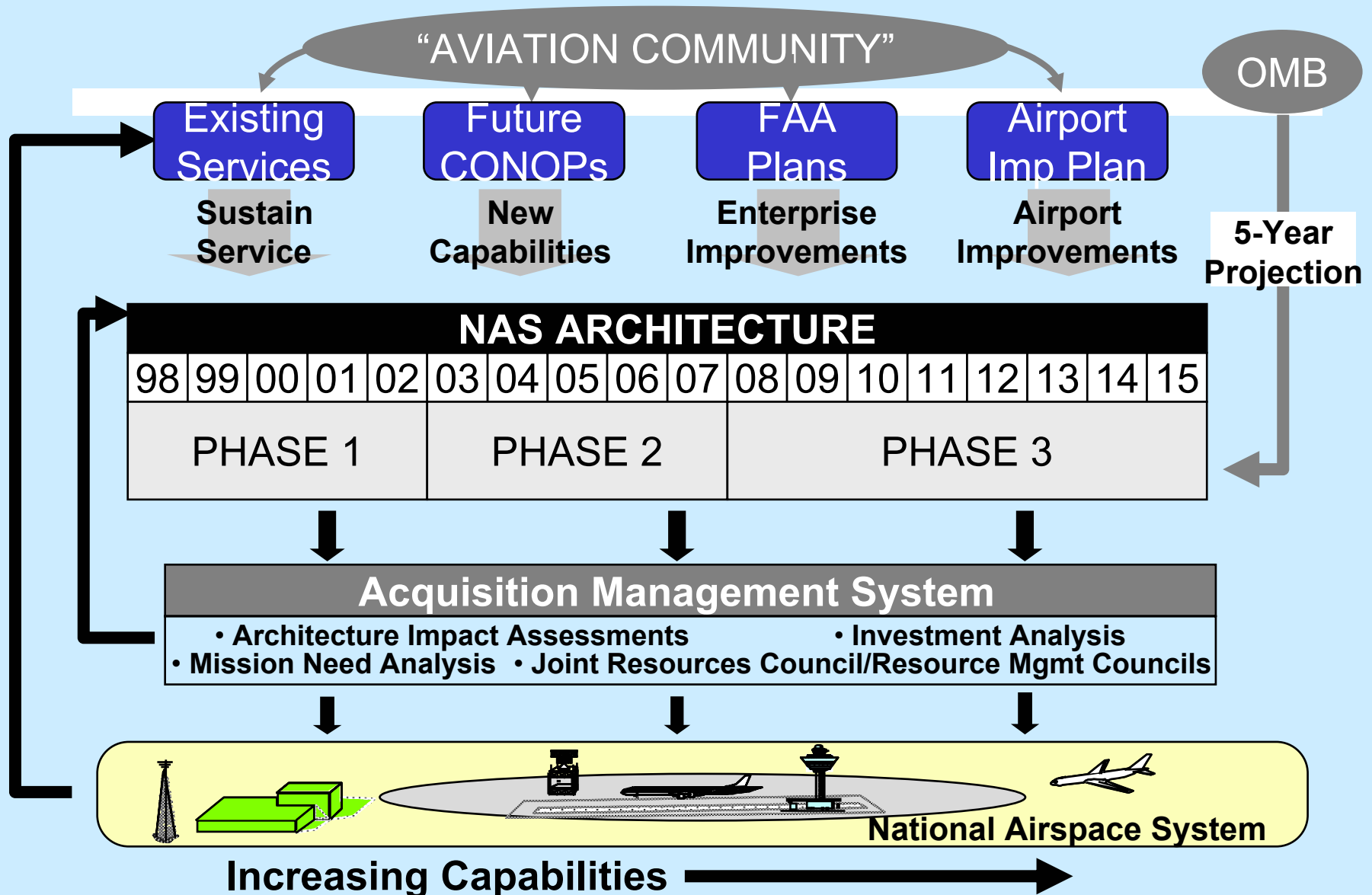
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Program Director

FAA Architecture and Systems
Engineering

Seven Modernization Goals

- **Safety**
- **Accessibility**
- **Flexibility**
- **Predictability**
- **Capacity**
- **Efficiency**
- **Security**

NAS Modernization Process



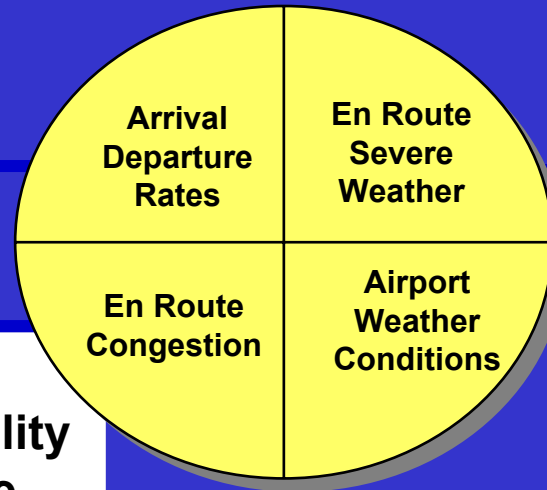
Integration of Commitments



Operational Evolution Plan (OEP) Goals

- **Describe the operational evolution of the NAS as it relates to increasing capacity while increasing safety**
- **Derive a set of credible initiatives that focus the aviation community on solutions for the 2000-2010 timeframe**
- **Link these initiatives to a timetable and specific activities (e.g., procedure development, avionics packaging, system acquisition) required of each member of the community**
 - **Prioritize and integrate initiatives**
 - **Commitment by the FAA with accountability**
 - **Seek support by the aviation community**

Capacity/Delay Message



Today 15 airports have throughput problems

Most Flexibility is gone

More than half the delays come from weather

Increase terminal Throughput

New runways and configurations provide the largest gains

Some efficiency gains are possible from closing gaps in arrival or departure streams

Taxi times need to be managed as traffic on the surface increases

Add flexibility to reduce interaction between flows

The immediate need is to match resources to the high demand areas

In parallel, we must take advantage of new aircraft capabilities

Allow users more flexible routing

Keep terminal throughput closer to visual levels in all weather conditions

The long-term answer is an all weather capability, reducing the effect weather has on arrival & departure rates

A coordinated reconfiguration of the airport reduces runway down time

Minimize impact of visibility on surface movement to keep taxi and gate times from growing

Increase user flexibility to manage contingencies

A short-term answer is joint planning to reduce the effects of the uncertainty in the forecast

Work with pilots to find the best routing around the weather

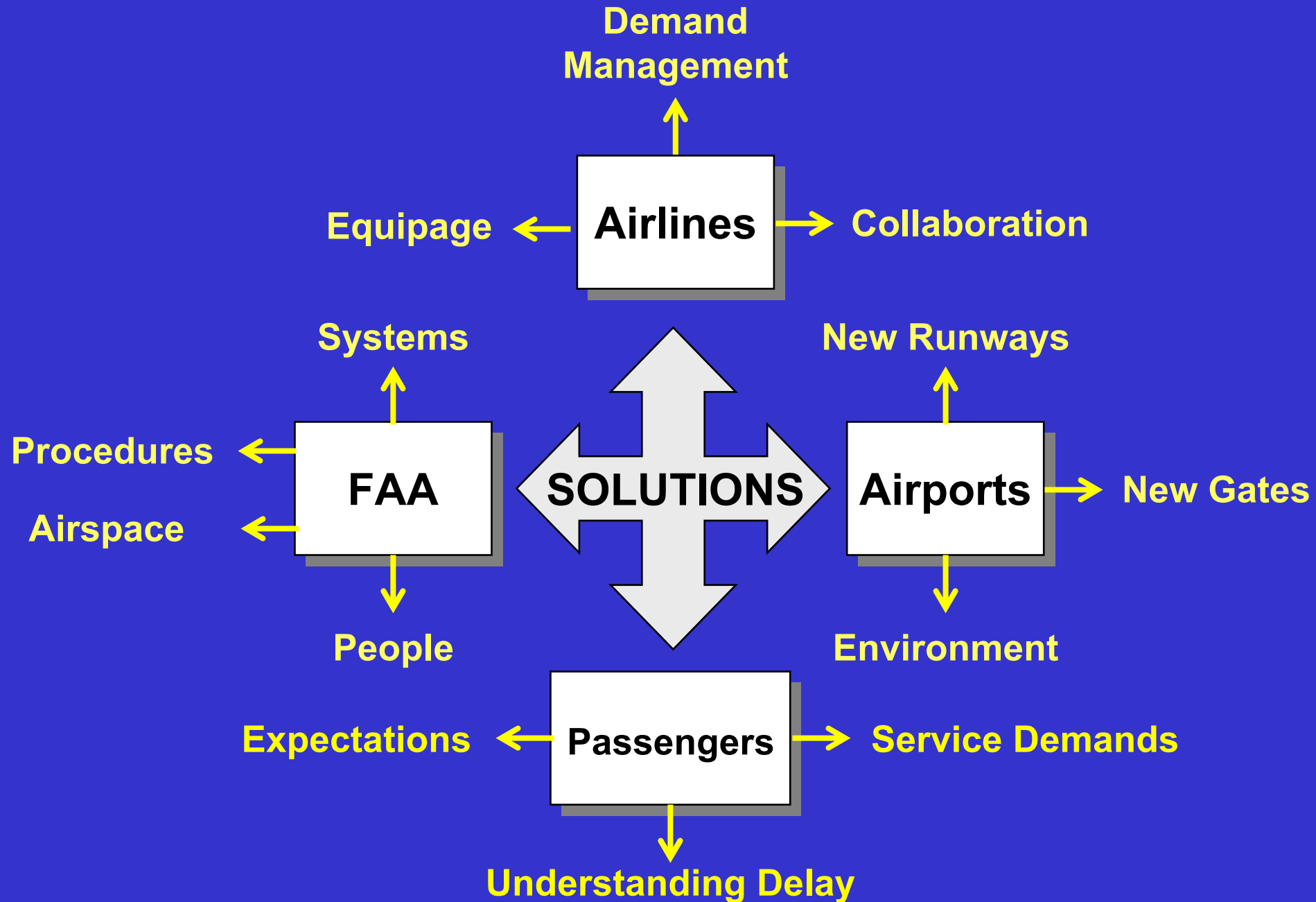
31 Airports = 2/3rd of passengers

15 airports = more than 80 % of delay

6 of these = over 50 % of delays

LGA - EWR - ORD - SFO - BOS - PHL

Capacity/Delay Message – The Players



Research Areas in NAS Modernization

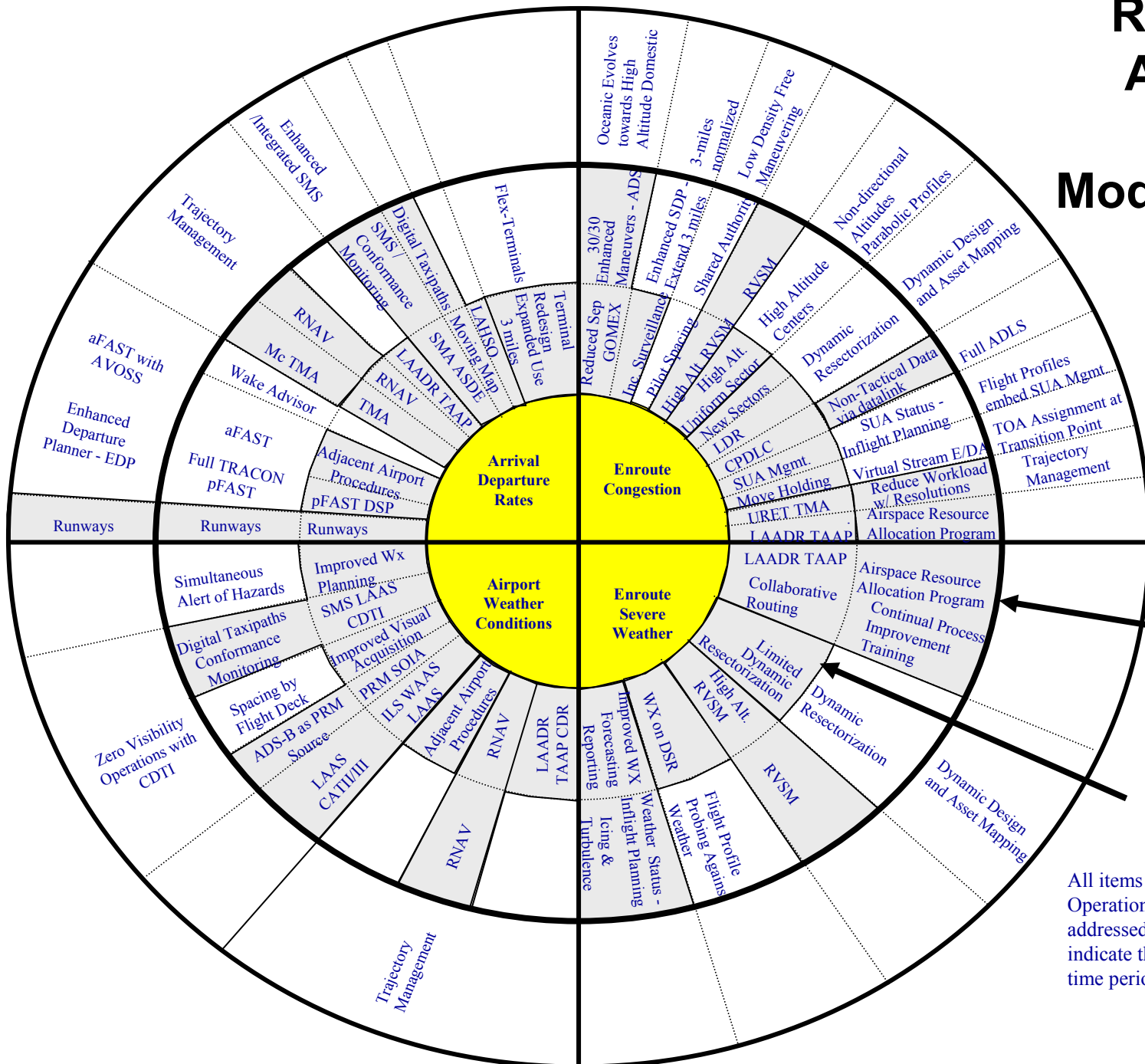
Covered in OEP

2015

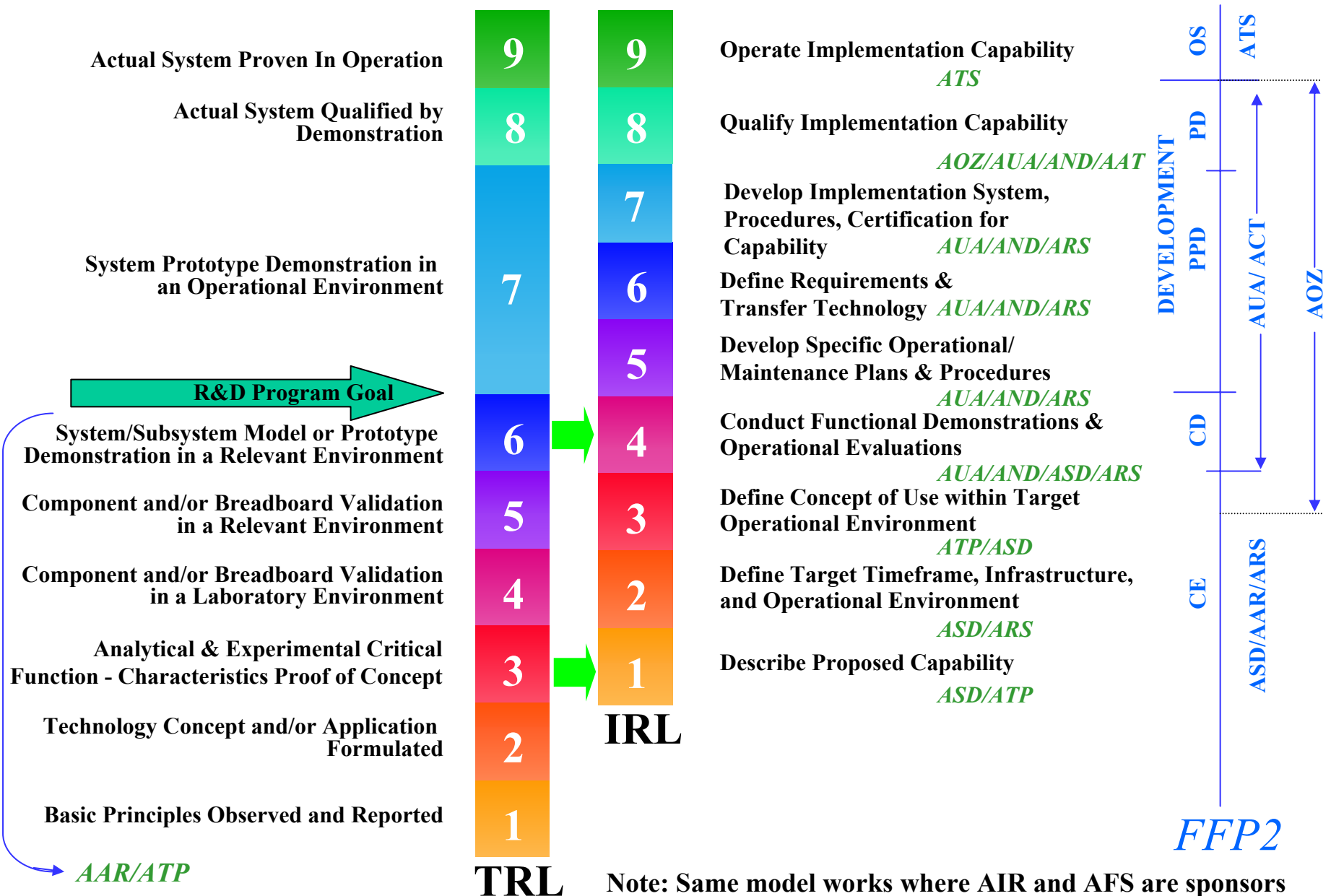
2010

2005

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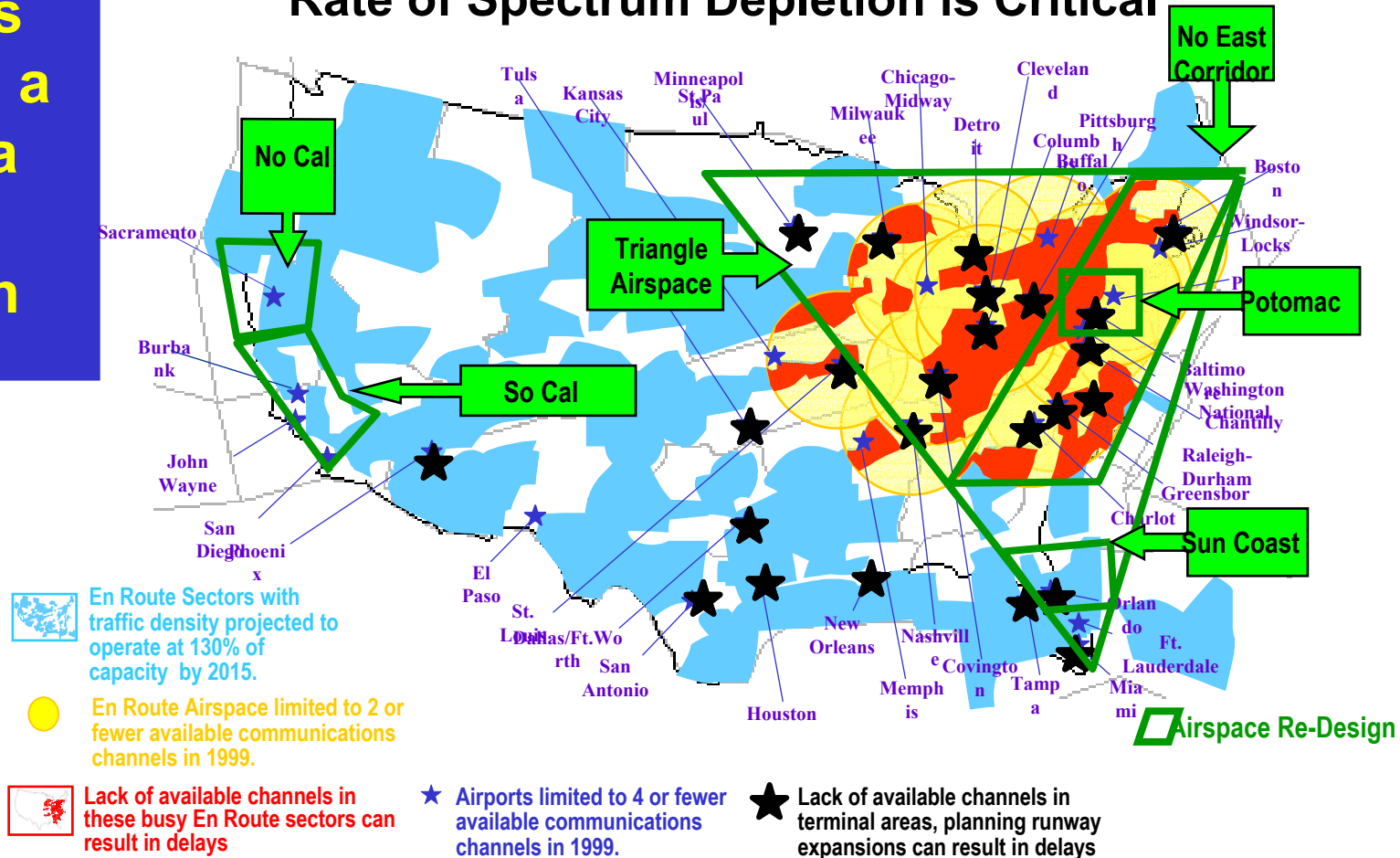
Technology & Implementation Readiness



Spectrum - We Are Running Out of Time...

The end is 2010, with a need for a 5-7 year transition

Rate of Spectrum Depletion is Critical



2015 En Route Traffic Projection with Current VHF Communications Channels

Current Communications

- **Separate networks for voice and data; separate operations and administrative networks; mix of owned and leased; old technology.**
 - Inefficient and costly
 - Limits NAS modernization and growth
- **Voice switch technology 10-20 years old with growing supportability problems; many FAA-unique interfaces.**
 - Complicates transition to digital network
- **Approximately 40,000 analog radios with growing supportability problems.**
 - Inefficient use of overcrowded spectrum

Communications Highlights

- **Modern ground telecommunications infrastructure**
 - Integrated digital network for voice, data, and video
 - Different classes of service to meet operations and administrative user needs
 - Improved network monitor, control and usage data
- **Next generation air-ground communications**
 - Digital radios for voice and data communications (continue to operate UHF radios for DOD users)

Communications Summary

- **Migrate to all-digital communications to take advantage of newer, lower-cost technology and services and provide seamless communications for NAS users.**
- **Integrate voice, data and video networks for greater efficiency, better management, and lower cost.**
- **Migrate to telecommunications industry protocols and standards to simplify interfaces and reduce cost.**
- **Transition to digital radios for better spectrum utilization.**

Current Data Link

- **Limited Data Link Capability**
 - **Available through a Commercial Service Provider**
 - **ACARS (analog system)**
- **Domestic**
 - **57 Busiest Airports in the Terminal/Tower domains**
 - **Two sets of messages: Predeparture Clearance and Weather Information**
 - **Detroit Airport - (Prototype)**
 - **One message: Taxi Clearance**

Current Data Link (concl.)

- **Oceanic**
 - **Limited Controller Pilot Data Link Communications (CPDLC) for aircraft equipped with the Future Air Navigation System (FANS)**
 - **Available at multi-sectors in Oakland Center**
 - **Service Provider**
- **Other Data Link Services - Different Stages**
 - **Traffic Information Service (TIS) provides situational awareness information via Mode-S**
 - **Service available at approximately 90 terminal Mode-S sites**
 - **Initial Flight Information Service (FIS) will provide weather, NOTAM, and SUA data**

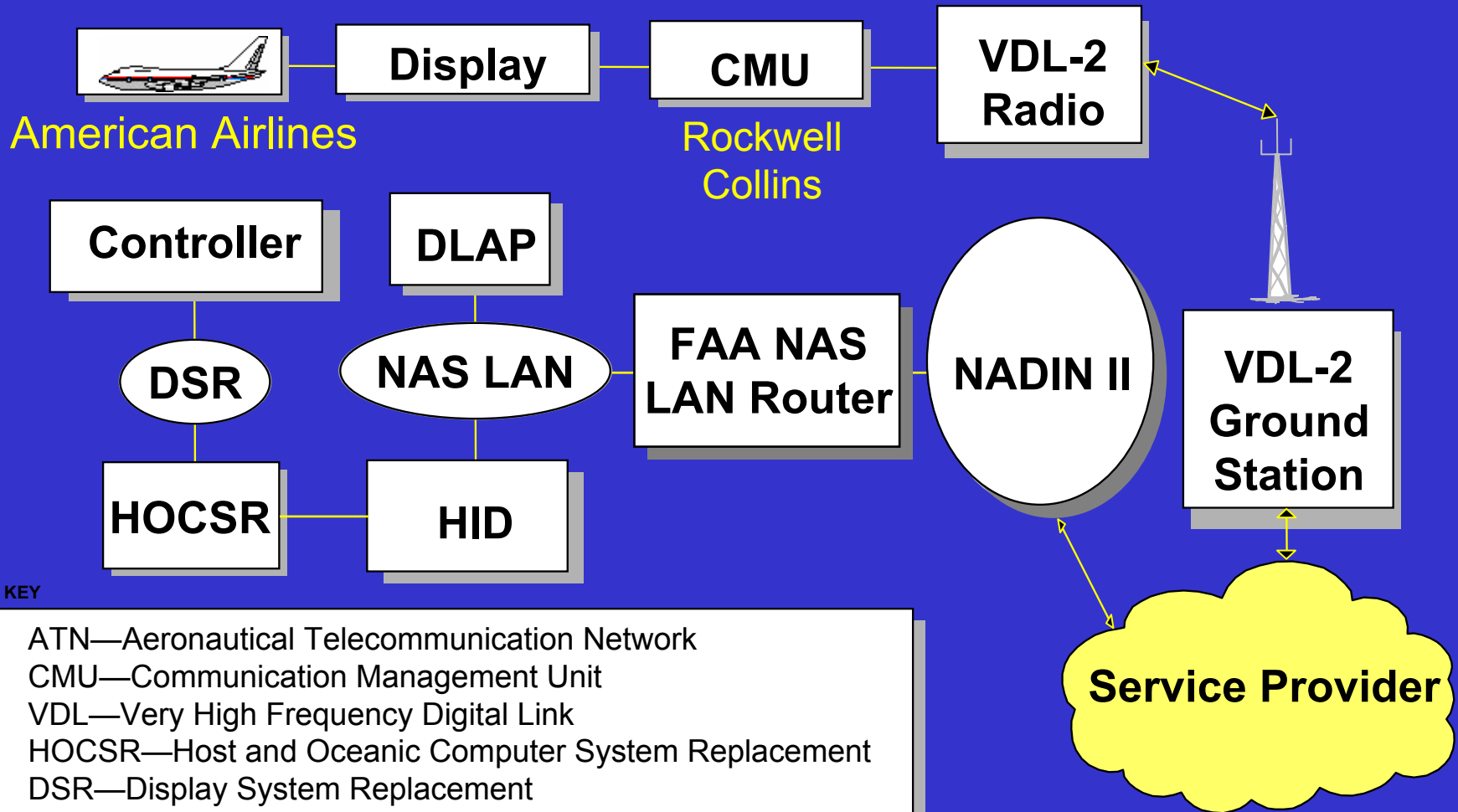
Data Link Evolution

- Using new digital data link technology we will introduce CPDLC messages to the en route domain
 - Objective: gain operational experience
- Build 1 - Miami. Messages:
 - Initial Contact
 - Transfer of communications
 - Altimeter setting
- Build 1a - National for En-route. Messages:
 - Altitude
 - Heading
 - Speed
 - Route Clearance
 - Pilot-initiated downlink

**No Operational
Commitment Beyond
Build 1a**

Data Link Evolution (cont.)

CPDLC Build 1: Miami/American Airlines



KEY

ATN—Aeronautical Telecommunication Network
CMU—Communication Management Unit
VDL—Very High Frequency Digital Link
HOCSR—Host and Oceanic Computer System Replacement
DSR—Display System Replacement
LAN—Local Area Network
HID—HOCSR Interface Device
DLAP—Data Link Applications Processor

Navigation Transition

- **Current navigation aid (NAVAID) assets continue through transition**
- **Navigation and Landing Highlights**
 - **SATNAV and RNAV**
 - **Augmentation of GPS necessary**
- **Evolution of Navigation goes beyond just navigation and landing**
 - **ADS-B**
 - **Comm Timing**
 - **Moving Maps**

Public Use Approaches

AVN Development Efforts and Plans (Safer Skies)

- ➔ 12,600 instrument approaches exist
- ➔ 3,009 GPS non-precision approaches (LNAV only)
 - ➔ 2,427 published
- ➔ 529 LNA/VNAV approaches developed
- ➔ 56 published since October 2000

Next Steps

- 2,528 approaches at 576 airports by 2006 (Part 139 airports)
- ➔ 2,864 approaches at 788 airports by 2010 (runways > 5,000')
- ➔ 4,450 approaches at 1,300 airports after 2010 (runways < 5,000')
- ➔ LAAS acquisition and fielding starts in FY 02
 - ➔ Operational approval of Part 171 LAAS CAT I systems (non-fed)
 - ➔ Contract award for first 20 of 60 LAAS units
- ➔ WAAS LNAV/VNAV test, evaluation and acceptance in FY 02
- ➔ WAAS IOC in 2003 for LNAV/VNAV
- ➔ Additional geostationary satellite services decision is in review

RNAV comes in many flavors

- /I** - LORAN, VOR/DME, or INS, Transponder with Mode C
- /E** - Flight Management System (FMS) with redundancy
- /F** - Single FMS that meets /E, requirements (a) through (d)
- /G** - GPS/GNSS equipped
- /R** - Required Navigation Performance (RNP)

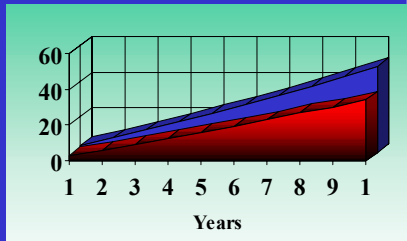
Overlays - procedures that overlay existing ground tracks

Non-overlays - procedures that create new ground tracks

Specials - tailored procedures for exclusive use of a particular operator

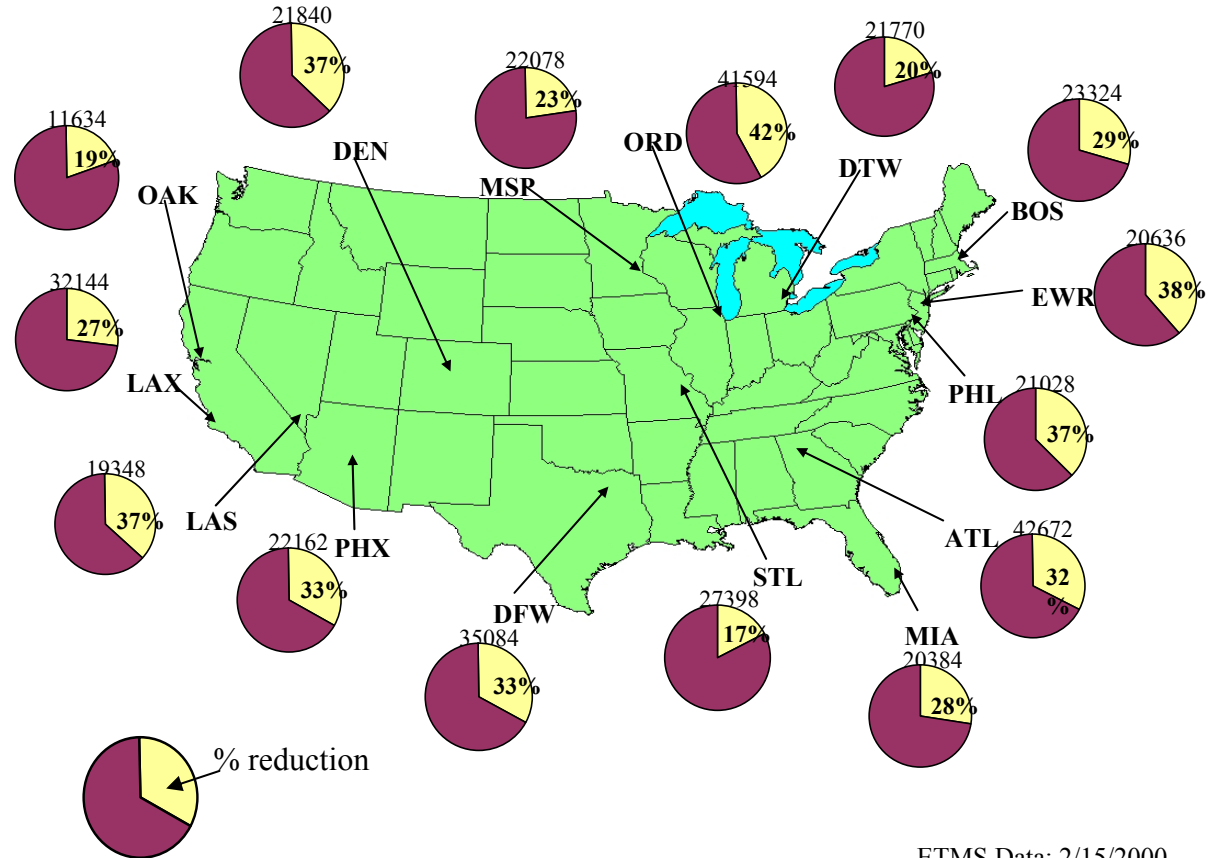
Public - published and available to all properly equipped aircraft

Reduced Channel Congestion Through RNAV



**Traffic Growth
Will Continue**

RNAV Arrival Routes and Procedures Show Promise



ETMS Data: 2/15/2000

RNAV Activities in OEP

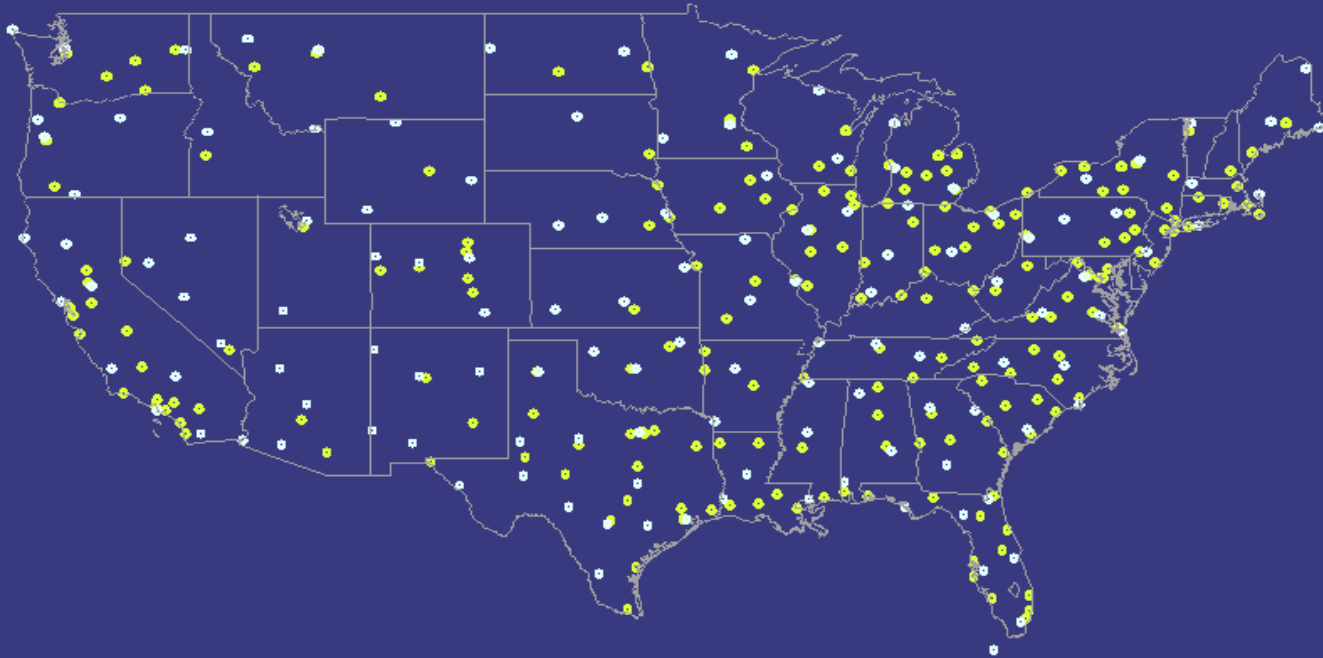
- ➔ **Safer Skies commitments for precision approaches will be met procedure schedules can be found at**
- ➔ **IAPA tools and Flyability Model will be made available**
- ➔ **RNAV capacity initiatives being defined and work increases in AVN will be supported**
- ➔ **Airlines need to participate in priority setting our data shows we are delivering RNAV procedures**
- ➔ **OEP adds resources for RNP/RNAV and support public use transition**

<http://www.mmac.jccbi.gov/avn>

Surveillance Modernization

- **ARSR-4 - Complete FY1999**
- **ASR-11**
 - Funding through FY2008 for radars
 - SI and ASTERIX mods in CIP; SI complete 2010, ASTERIX complete 2008
- **ASR-9 Service Life Extensions**
- **ATCBI-6**
 - Funding to FY2005; complete 2004
- **ASDE-3 Improvements**
- **ASDE-X**
 - Funding FY2005; complete 2005
- **ADS-B - Enters as Pockets and NAS-wide starting in 2007 ~900 ADS-B ground stations**

FAA Radar Sensors Are Extensive, But...



Radar Sites

116 LRR

220 ASR

34 ASDE

Terminal ATC Facilities

171 TRACONS

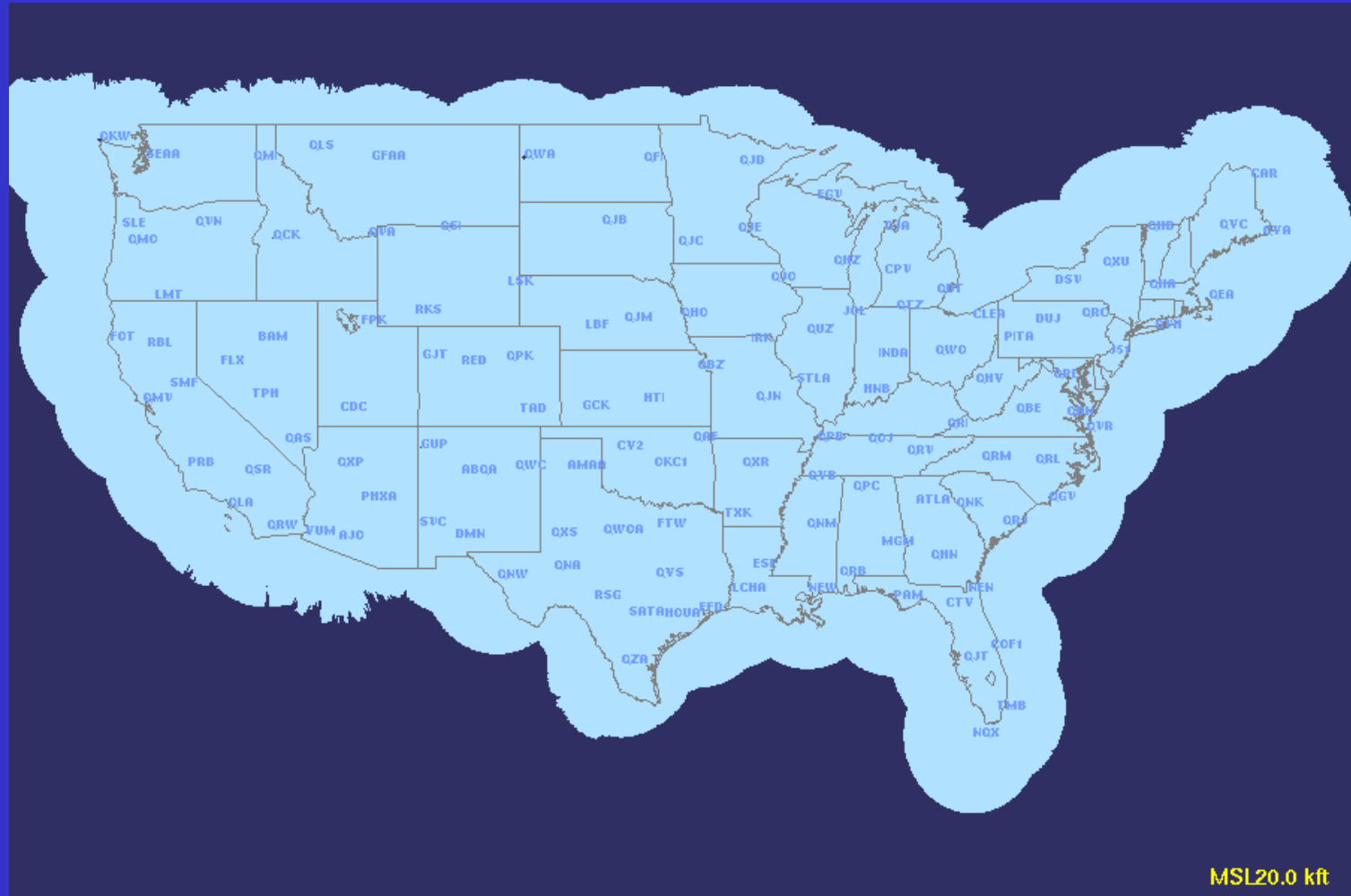
3 Offshore sites

20 En Route ATC Facilities

3 Oceanic ATC
Facilities

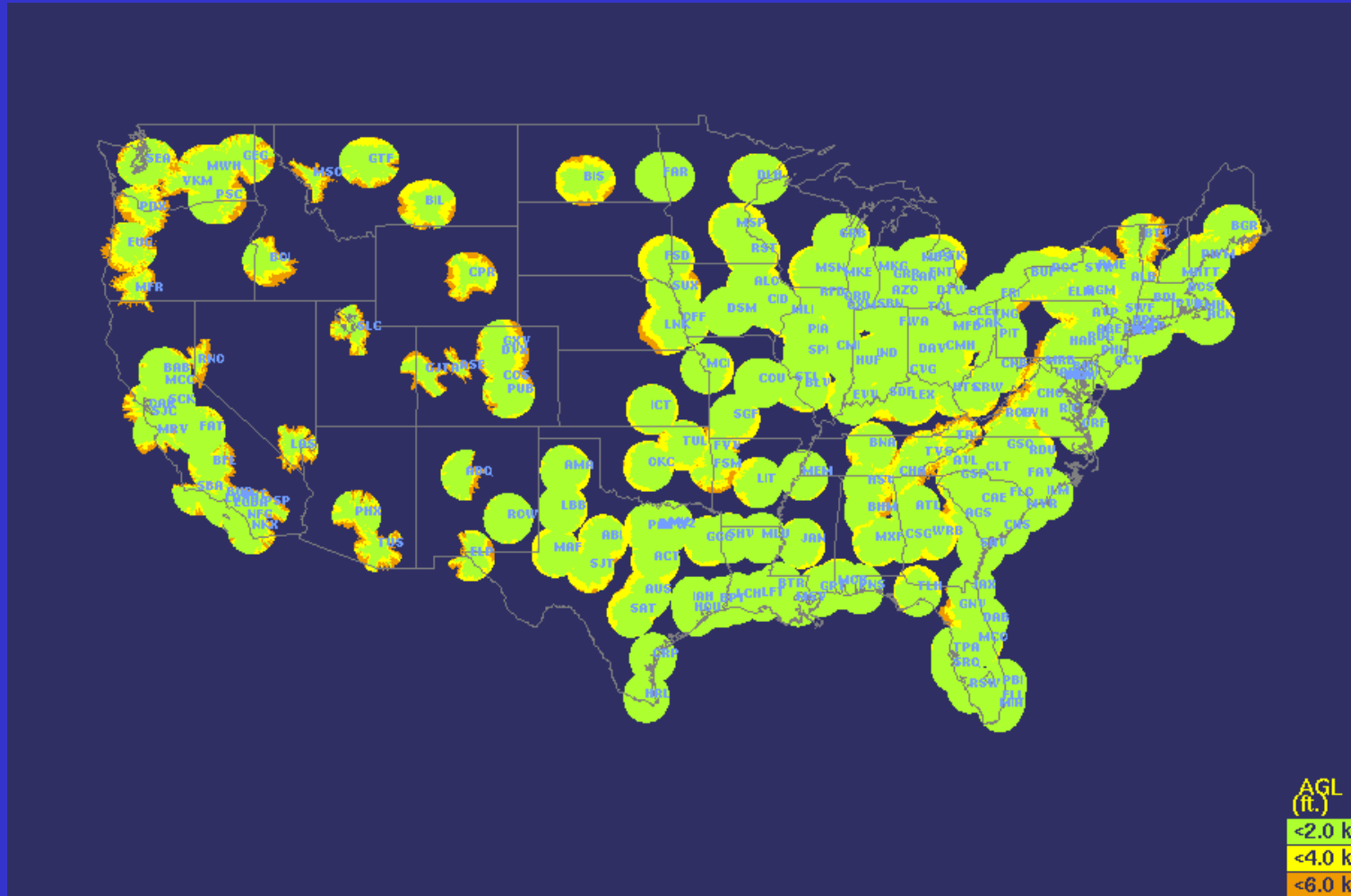
FAA CONUS En Route Radars

FL 200 Coverage



FAA CONUS Terminal Radars

2, 4, and 6000 feet AGL Coverage



Initial Set of ADS-B Functions...

Safety

Surface movement with surveillance and navigation (ADS-B/CDTI/TIS-B)

Surveillance in non-radar airspace with radar-like separation (ADS-B or ADS-B/CDTI/TIS-B)

Improved see and avoid capabilities (ADS-B/CDTI/TIS-B)

Efficiency

Surface movement with surveillance and navigation (ADS-B/CDTI/TIS-B)

Surveillance in non-radar airspace with radar-like separation (ADS-B or ADS-B/CDTI/TIS-B)

Oceanic ADS-A leading to 30/30 nm and 1,000 feet separation (ADS-A)

Visual acquisition for approaches (ADS-B/CDTI/TIS-B)

Candidate PRM replacement

...with a path to greater capacity benefit through evaluations under Safe Flight 21 with emphasis on certification safety and use for maneuvering

Investigate/Install New Surveillance Technologies

- **Evaluate and select Automatic Dependent Surveillance -Broadcast (ADS-B) Link**
- **Implement ADS-B applications shown beneficial in Safe Flight 21 and Capstone**
- **Investigate new airport surface surveillance systems**
- **Install new airport surface surveillance systems**
- **Develop next generation multipurpose terminal radar system (MPAR)**

Oceanic and Offshore Evolution

- **Advanced Technologies & Oceanic Procedures (ATOP)**
 - **Contract this Summer**
 - **30 x 30 x 1,000 feet in the Ocean**
- **Gulf of Mexico Challenges**
 - **Domestic Separation is the Goal - 5 miles everywhere**
 - **Surveillance is the Obstacle**
 - **Options**
 - **Beacons in the Gulf**
 - **ADS-B**
 - **NASA Helicopter Tracking System Using ADS-B & Multilateration**

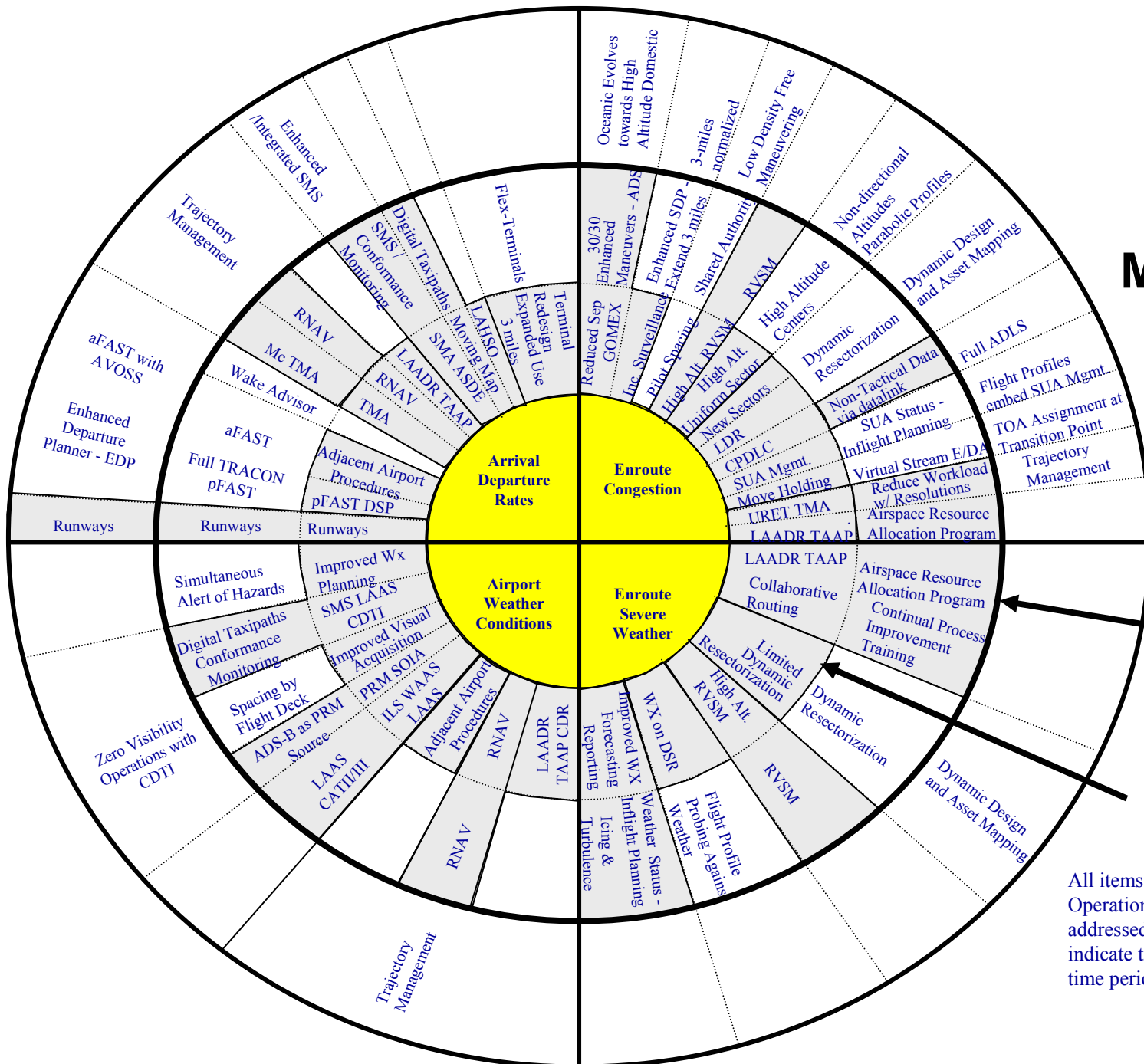
Research Highlights

- **Communications**
 - Investigation of LEO / MEO usage for Air Traffic Services
- **Surveillance**
 - Investigate combination of terminal surveillance radar and doppler weather radar into single multi-purpose airport radar -- begin 2008 for 2018 deployment
- **Aviation Weather**
 - convective weather, short-term ceiling and visibility predictions, turbulence, and wake vortices
- **Avionics - Reduce cost for general aviation**

Research Highlights (Cont'd)

- **Operational Planning**
 - Identify improvements for collaborative information sharing and decision making
 - Identify innovative uses of data (i.e. Flight Object)
- **Departure / Arrival**
 - Develop a simplified format for displaying surface, terminal, and wake vortex information for controllers
 - Investigate improvements based on increased data sharing between airline operations centers and aircraft
- **En Route / Oceanic**
 - Evaluate integration of flight object and 4-D flight profiles into decision support systems

Research Areas in NAS Modernization



2015

2010

2005

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